Congressional Notification Profile
DE-PS26-02NT41369

UNIVERSITY COAL RESEARCH PROGRAM, INNOVATIVE CONCEPTS PROGRAM
University of Maine

Background and Technical Information:

Project Title: "Inorganic Membranes for CO_2/N_2 Separation."

This project will chemically modify a porous membrane to enhance its ability to remove carbon dioxide from nitrogen in flue gas streams. Silica films will be deposited within a membrane to reduce pore size and an amine reagent will be used to initiate film deposition reaction and limit pore reduction. A homogeneous membrane with a specific pore size will be produced. Internal walls will be coated with an amino substance to enhance CO_2 sorption and surface diffusion.

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Congressional District: 02 District County: Penobscot

Financial Information:

Length of Contract (months): 12
Government Share: $49,951
Total value of contract: $49,951

DOE Funding Breakdown:
Funds: Phase and/or FY 2002 $49,951

Inorganic Membranes for CO_2/N_2 Separation

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Abstract

In order to comply with federal emission standards the energy and chemical processing industries have been steadily reducing CO_2 emissions for the last 10 years. Carbon dioxide scrubbing, using a caustic absorber column, is the most common way to reduce industrial CO_2 emissions. Both polymeric and inorganic membranes show promise for the separation of CO_2 from N_2. Porous inorganic membranes provide thermal and chemical stability over polymeric membranes and are therefore the most likely candidate for large scale industrial application.

The overall objective of research in inorganic membranes for gas separations is the controlled synthesis and production of thermally stable, defect-free supported films, with a perfect control of the microstructure (pore size, pore volume and surface area). Once this objective is met, inorganic membranes can be tailored for CO_2/N_2 separation by functionalizing the pore walls to enhance adsorption and surface diffusion of the CO_2 molecule.

A state-of-the-art thin, mesoporous MCM-48 SiO_2 layer deposited within the pores of a macroporous α-Al_2O_3 support will be chemically modified to attain a uniform and controlled pore-structure. Silica films will be deposited within the porous MCM-48 using a catalyzed binary reaction sequence, referred to as atomic layer deposition. A critical aspect of this project is the use of a Lewis base (amine) to catalyze the film deposition reaction. The pore reduction reaction will proceed until the catalyst is excluded from the pore. The size of the Lewis base will self-limit the pore-size reduction resulting in a homogeneous membrane with a specific pore size. Once a monodisperse pore size is attained a final modification step will be employed to functionalize the internal pore walls with aminopropyl groups in order to enhance sorption and surface diffusion of CO_2.